

RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: 1st

Wisconsin Department of Transportation
DT1241 2009

Research, Development and Technology Transfer	
Program: (Choose One)	
<input type="checkbox"/> Policy Research	<input type="checkbox"/> Pooled Fund TPF #
<input checked="" type="checkbox"/> Wisconsin Highway Research Program	<input type="checkbox"/> Other
Project Title: Reduction of Minimum Required Weight of Cementitious Materials in WisDOT Concrete Mixes	
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WisDOT Technical Contact/Phone #: James Parry	Other Project ID:
Project Investigator/Phone # (agency & contact): Larry Sutter, Michigan Tech Transportatin Institute	Approved Starting Date: 10/22/2007
WisDOT Comments:	Original End Date: 10/22/2009
	Current End Date:
Sponsor: Wisconsin Department of Transportation	Number of Extensions:

Schedule Status:

- On schedule Ahead of schedule
 On revised schedule Behind schedule (Please explain below)

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
\$114,938.00	\$0.00	\$65,551.97	57%	65%

Project Description:

The objectives of this research project are to make recommendation values for minimum CMC to be used by WisDOT for future pavement mixes and to make recommendations to WisDOT for future work in this area.

Progress This Quarter: (Includes project committee meetings, work plan status, contract status, significant progress, etc.)

Test Batches

After receiving permission to change the fine aggregate used with the northern coarse aggregate, a set of test batches was made to investigate the affect of changing coarse aggregate gradation on the slump of concrete. Table 1 shows the coarse aggregate gradations that were used in these test batches.

Sieve Size	Specification	Middle	Fine
3/4	90-100	5.13	0.00
3/8	20-55	57.18	45.00
#4	0-10	32.73	45.00
#8	0-5	4.97	10.00

The test batches were made with a local aggregate source to minimize usage of the northern coarse aggregate on hand. The local aggregate is crushed basalt from Moyle Construction. The initial batches were made with only portland cement. The second set of mixes was made with 30% fly ash substitution. The results of these mixes are shown in Figure 1. Changing the gradation of the coarse aggregate shows little or no effect on the slump of the mixes and the decision was made to continue the use of a gradation that is in the center of specification limits.

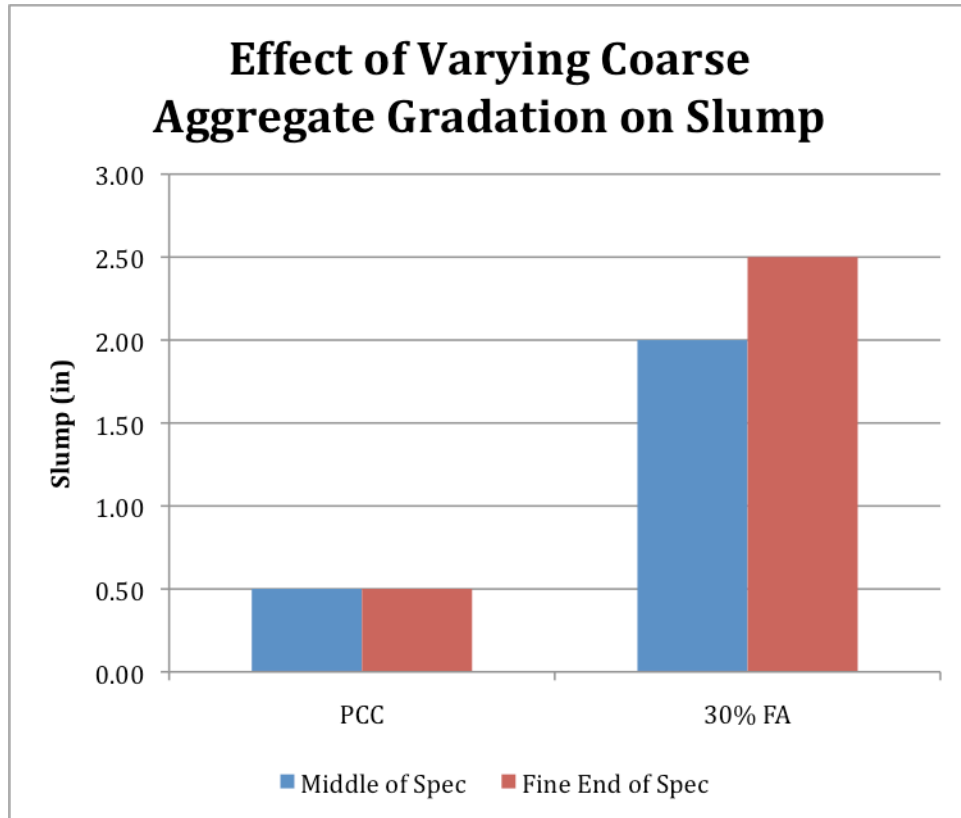


Figure 1. Slump Results of Test Batches Made with Varying Coarse Aggregate Gradations.

Further test batches were made with northern and southern aggregate sources. Results of these batches are shown in Figure 2. The slump of the test batches is higher than acceptable. The northern batch had an air content of 7.5% while the air content of the southern batch was 4.5% as measured by the volumetric method (ASTM C173). Conventional wisdom states that a one percent change in air content will change the slump of a mix by one inch. If the air contents were optimized to 6%, the slump of the northern mix would be at the high end of the acceptable range (~3 inches) and the slump of the southern mix would be farther out of range (~9 inches). This indicates that further measures to reduce slump need to be taken.

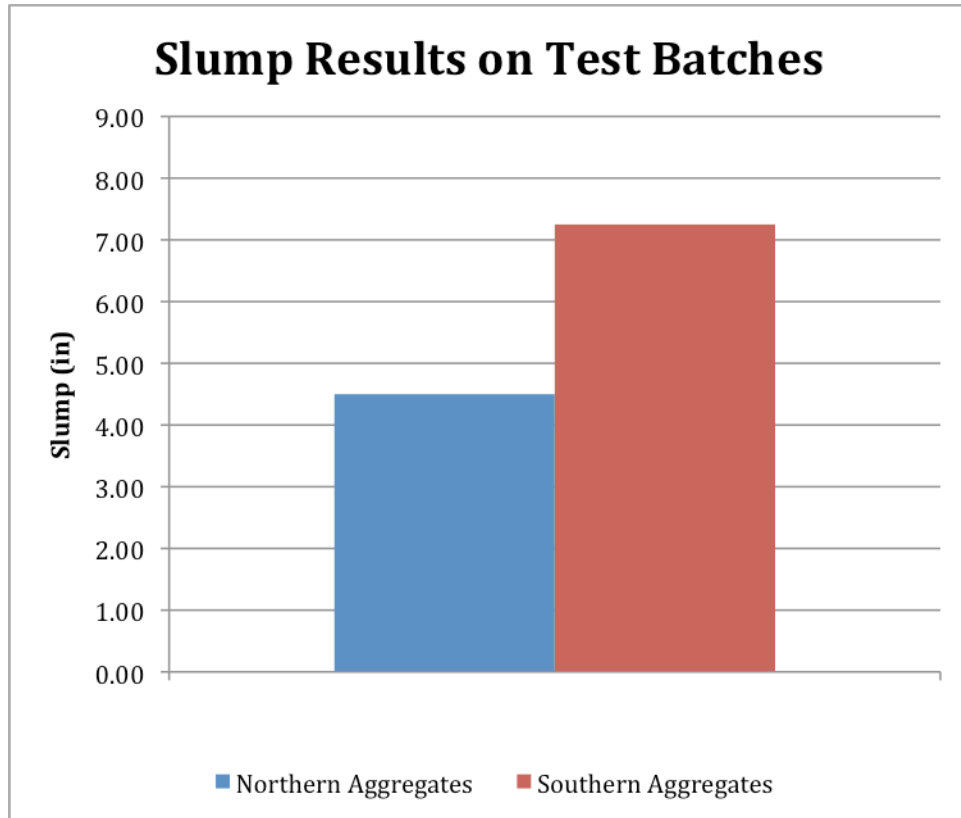


Figure 2. Slump Results of Test Batches.

Test batches were made with reduced water/cementitious materials ratio. Figure 3 shows the results of these batches as compared to the previous mixes. Reducing the w/cm ratio has a drastic affect on the slump of the mixes. The air contents of these two batches are 4.5% for the northern and 4% for the southern. Again, applying conventional wisdom, the slump of southern mix will be outside of the acceptable range at ~5 inches. Therefore, further reduction of the slump is necessary.

Test batches were made with the coarse to fine ratio changed from 60/40 to 55/45 while maintaining the 0.40 w/cm ratio. Figure 4 shows the results of these batches as compared to the previous 0.40 w/cm ratio mixes. The measured air content of these mixes is 5% for the northern mix and 5.5% for the southern mix. These results are within the specifications of the project and these conditions will be used to produce the final batches.

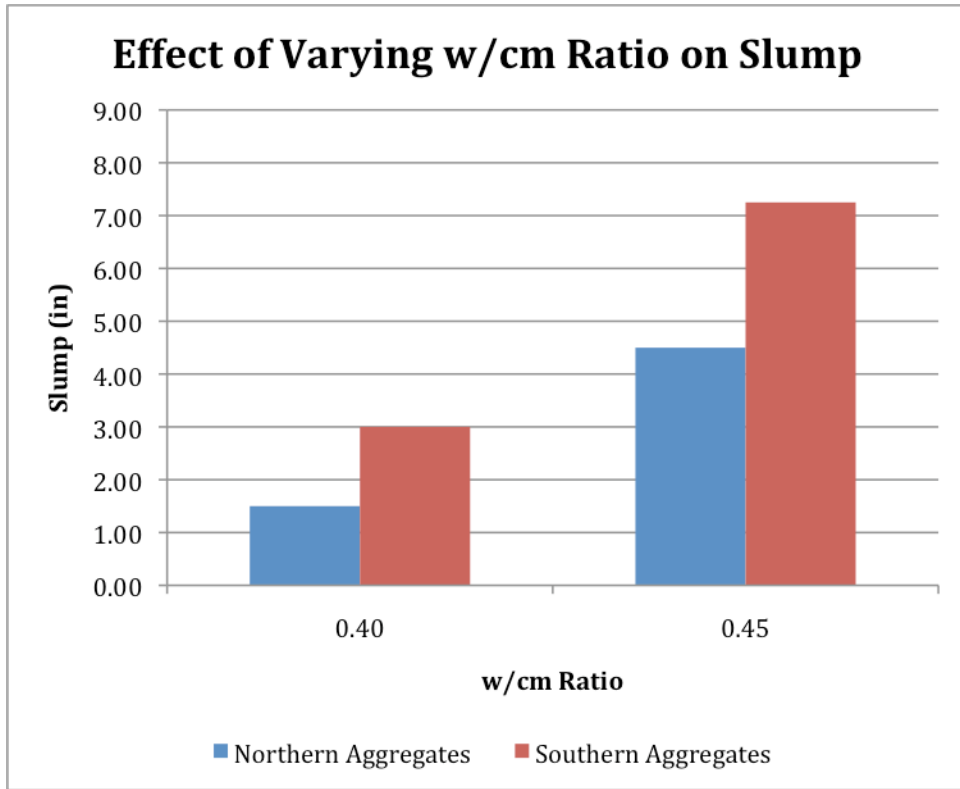


Figure 3. Slump Results of Test Batches made with Varying w/cm Ratio.

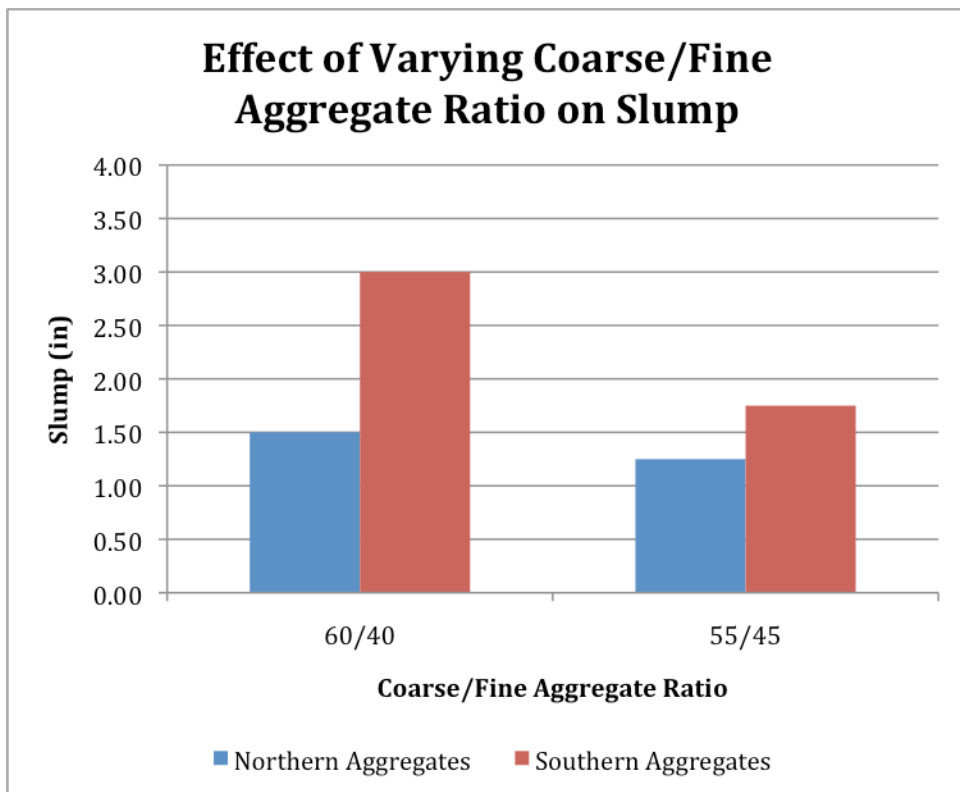


Figure 4. Slump Results of Test Batches made with Varying Coarse/Fine Aggregate Ratio.

Completed Mixes – 9 mixes were made using a coarse to fine ratio of 55/45 and a 0.40 w/cm ratio. The mixes were made with the following components:

1. 564 CMC, Fly Ash 1, PC1, northern aggregate
2. 564 CMC, Fly Ash 2, PC1, northern aggregate
3. 564 CMC, Fly Ash 1, PC2, northern aggregate
4. 564 CMC, Fly Ash 2, PC1, northern aggregate
5. 564 CMC, GGBFS, PC2, northern aggregate
6. 564 CMC, Fly Ash 2, PC1, southern aggregate
7. 564 CMC, Fly Ash 1, PC2, southern aggregate
8. 564 CMC, Fly Ash 2, PC2, southern aggregate
9. 564 CMC, GGBFS, PC2, southern aggregate

Fly Ash 1 is from the Columbia source; Fly Ash 2 is from the Weston source. GGBFS is ground granulated blast furnace slag from Holcim. PC1 is Lafarge Type I/II cement and PC2 is St Marys Type I cement.

Testing – Table 2 shows the status of testing that is being performed on the 9 mixes listed above. Numbers in parentheses are the applicable ASTM specification. Complete = Testing is completed, IP = in process, DC = dry curing, MC = moist curing, numbers indicate the day of testing that is completed. For example, “3,7,28” under Compression indicates that 3-day, 7-day and 28-day compression testing have been completed, while 90 day testing remains uncompleted.

Mix	Fresh Testing ¹	Compression (C39)	Split Tensile (C496)	Modulus-Poissons (C469)	Freeze-Thaw (C666)	Length Change (C157)	Absorption (C1585)	RCPT (C1202)
1	Complete	3,7,28	3,7,28	Complete	DC	28	MC	MC
2	Complete	3,7	3,7	MC	MC	28	MC	MC
3	Complete	3,7	3,7	MC	MC	28	MC	MC
4	Complete	3,7	3,7	MC	MC	28	MC	MC
5	Complete	3,7	3,7	MC	MC	28	MC	MC
6	Complete	3,7	3,7	MC	MC	28	MC	MC
7	Complete	3,7	3,7	MC	MC	28	MC	MC
8	Complete	3,7	3,7	MC	MC	28	MC	MC
9	Complete	3,7	3,7	MC	MC	28	MC	MC

¹-Fresh testing includes Slump (C143), Pressure Air (C231), Volumetric Air (C173), Unit Weight (C138). AdiaCal and Air Void Analyzer testing are also included in the fresh testing.

Work Next Quarter:

Finish the remaining mixtures and continue testing

Circumstances Affecting Progress/Budget:

none

